TSUNAMI NEWSLETTER

APRIL 1987
VOLUME XX, No. 1

INTERNATIONAL
TSUNAMI
INFORMATION
CENTER

INTERGOVERNMENTAL
OCEANOGRAPHIC
COMMISSION

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TSUNAMI NEWSLETTER is published by the International Tsunami Information Center to bring news and information to scientists, engineers, educators, community protection agencies and governments throughout the world.

We welcome contributions from our readers.

The International Tsunami Information Center (ITIC) is maintained by the U.S. National Oceanic and Atmospheric Administration (NOAA) for the Intergovernmental Oceanographic Commission (IOC). The Center's mission is to mitigate the effects of tsunamis throughout the Pacific.

MEMBER STATES

Present membership of the IOC International Coordination Group for the Tsunami Warning System in the Pacific (ITSU) comprises of the following States:

AUSTRALIA
CANADA
CHILE
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COOK ISLANDS
DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA
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NEW ZEALAND
PERU
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REPUBLIC OF KOREA
SINGAPORE
THAILAND
UNITED KINGDOM (HONG KONG)
USA
USSR
WESTERN SAMOA

FEATURE

An Analysis of the Dispersive Characteristics of the 7 May 1986 Tsunami

by George Pararas-Carayannis
Director, International Tsunami Information Center

Introduction

Tsunamigenic anomalies can be explained either by variation in seismic source parameters of generating earthquakes (magnitude and depth of the earthquake, orientation and rupture length, dip of the fault, size of crustal displacements, sedimentary coupling), or by variations in propagation and energy focusing characteristics. For example, the 1946 tsunami was anomalously efficient considering the magnitude of the earthquake that generated (7.4). In this case optimal combination of seismic source parameters and sedimentary coupling must have been responsible for the generation of this large and very destructive tsunami. Other very large earthquakes in the Southwest Pacific historically have produced very small tsunamis.

Except for magnitude, some of the source parameters of the May 7, 1986 earthquake (magnitude 7.7) were very similar to those of the March 9, 1957 earthquake, which was responsible for a very destructive tsunami (Pararas-Carayannis 1986). Similarly, initial tide gauge tsunami measurements of the 1986 tsunami at Adak and Midway Island, although not as high as those of the 1957 event, were high enough to cause concern that a large tsunami had been generated. Surprisingly the May 7, 1986 tsunami did not result in a significant tsunami in the Hawaiian Islands, or elsewhere. In the absence of earthquake source data, a preliminary analysis was undertaken during the real time investigation in an effort to predict tsunami heights in Hawaii and elsewhere, using the initial tsunami heights reported from Adak and Midway and geometric dispersion, and to compare these estimates with estimated and observed tsunami heights of the 1957 event. It was recognized that such estimates would be crude and that seismic source differences, rather than differences in propagational and focusing effects, were more important. The following are the results of this preliminary investigation:

Dispersion

For two dimensional (X, Z) dispersive tsunami waves, the maximum height decay with distance is theoretically proportional to $X^{-1/2}$ at great distances from the source. For three-dimensional (r, S) dispersive tsunami waves, the height-change relationships with distance conforms to r^{-1}.

The width of such three dimensional tsunami waves, propagating away from their generating source, at any time will be:

$S = So \quad \sin\theta$

where So = widest wavefront at an arcual distance of 90° degrees away from the source and θ = is the great circle distance expressed in degrees.

For a constant depth ocean, the tsunami amplitude A is related to

$$A^2 \propto S^{1/2} = \frac{1}{\sqrt{S_o \cdot \sin\theta}}$$

$$\text{or} \quad A \propto (\sin\theta)^{-1/2}$$

where S is the width of the tsunami wavefront.

Even though the ocean does not have a constant depth, a first order approximation of tsunami height with distance can be obtained, assuming a direct path, and only dispersion.

If A_1 is the amplitude (double amplitude-trough to crest) of the tsunami at one tide gauge station, and A_2 is the amplitude of the tsunami recorded at another tide gauge station, and θ_1 and θ_2 are the respective great circle distances expressed in degrees of arc from these stations to the tsunami origin, then an estimate of tsunami amplitude A_1 at the first station can be obtained based on the recorded amplitude (A_2) at the second station. Based on the previously stated assumptions of dispersion and taking the ratios of the amplitudes, we have the following relationships:

$$\frac{A_1}{A_2} = \frac{(\sin\theta_1)^{-1/2}}{(\sin\theta_2)^{-1/2}}, \qquad \frac{A_1^2}{A_2^2} = \frac{\sin\theta_2}{\sin\theta_1}$$

and

$$A_1 = A_2 \sqrt{\frac{\sin\theta_2}{\sin\theta_1}} .$$

Based on this approximation a comparison was made of the 9 March 1957 and the 7 May 1986 tsunamis. Since the origin of the two events was approximately the same and the travel paths and periods very similar, A_1 values (Honolulu - Hilo) were estimated based on A_2 values for

each event at different stations and then compared to what was actually observed, in an effort to be determine to what extent dispersion was a factor and whether an approximate prediction of the tsunami heights could be made.

Estimates of A_1 values for stations in Hawaii (Honolulu, Hilo, Kahului, Nawiliwili) were obtained for the two events based on reported amplitudes (A_2), at stations in Alaska and in Midway Island as shown below.

		1986 Event		1957 Event	
Adak:	$\theta_2 = 2.5$	$A_2 = 1.75$ m			
	θ_1	Computed(m)	Actual(m)	Computed(m)	Actual(m)
Honolulu	32.58°	.50	.40		
Hilo	35°	.48	.55		
Kahului	33.42°	.49	.36		
Unalaska:	$\theta_2 = 5.9°$	$A_2 = .25$ m		$\theta_2 = 5.9°$	$A_2 = 1.37$ m
Honolulu	32.58°	.11	0.40	.60	.97
Hilo	35°	.11	.55	.58	2.71
Kahului	33.42°	.11	.36	.58	3.41
Midway Is:	$\theta_2 = 22.85°$	$A_2 = .67$		$\theta_2 = 22.85°$	$A_2 = .82$ m
Honolulu	32.58°	.57	0.40	.70	.97
Hilo	35°	.55	.55	.67	2.71
Kahului	33.42°	.56	.36	.69	3.41
Honolulu:	$\theta_1 = 32.58°$	$A_1 = 0.40$		$\theta_1 = 32.58°$	$A_1 = 0.98$ m
Valparaiso (Chile)		0.32	0.25	0.78	2.04

TABLE 1

Computed and Actual Tsunami Amplitudes
at Selected Tide Stations for the 1986 and 1957 Tsunamis

Discussion:

The amplitude of the 1986 tsunami as recorded at Midway is a paradox. The value of 0.67 m is abnormally high compared to the 1957 amplitude of 0.82 m and considering the destructiveness of this tsunami in Hawaii and elsewhere. Although this analysis of dispersion does not show it, on the basis of the 0.67 m amplitude at Midway, a much bigger tsunami should have been expected in the Hawaiian Islands, and elsewhere. Considering that the origin of the two events were almost the same, the periods were almost the same (12-14 minutes), and the path of travel was very similar, the tsunami amplitude at Midway is inconsistent with historical precedence.

On the basis of this preliminary work it cannot be demonstrated that dispersion alone can be used for predictions of tsunami heights. Although tsunami height estimates for the 1986 tsunami based on this method, were not too far off the actual recorded values, the tsunami height estimates for the 1957 event deviated significantly for all terminal points from what was actually recorded. Although dispersion is one of the factors in the tsunami energy and height distribution across the ocean, tsunami source parameters, local conditions, and tsunami susceptibility of certain sites (e.x. Hilo) are much more significant, particularly for tsunamis generated from very large subductive type of earthquakes. Tsunami source mechanism and tsunami energy at the source are the more important factors in determining tsunamigenic efficiency for warning purposes. In the case of the May 7, 1986 earthquake as in the case of the September 19, 1985 Mexican earthquake, a short fault length and a shallow angle of subduction were the reasons for the small tsunamis (Pararas-Carayannis 1985).

Historically, using analysis of seismic surface waves it has been possible to estimate important earthquake source parameters, such as length, size, velocity, and orientation of an earthquake's surface rupture (Toksoz et al. 1965). Using the Rayleigh waves, Ben-Menahem (1961), developed a method of analysis of the earthquake source mechanism. However, none of these methods can be applied in real time. For better tsunami predictions, it is important to develop the means of determining seismic source parameters in real time. Too much reliance is placed on the Richter magnitude of an earthquake which is an absolute number, and represents presumably a relative measure of an earthquake's energy release. Magnitudes (Ms) of large earthquakes, as calculated presently using body- and surface-wave magnitudes scales m_b and M_S, based on recordings of high frequency seismic waves which include saturation effects, are underestimated. More accurate earthquake magnitude determinations for such events may be obtained from long period waves and determination of the seismic moment (Mo). The amplitude of long period waves is proportional to the surface area of the fault, the average displacement on the fault plane, and the rigidity of the material of the fault. By measuring the amplitude of such low frequency seismic waves it is possible to obtain the seismic moments of large earthquakes,

thus obtaining better measures of the earthquake's magnitude and energy release. Talandier et al (1986) have been working on a method that will permit real time calculation of the seismic moment of major earthquakes from recording of the initial Rayleigh waves at a teleseismic station. Application of this method holds promise for better assessments of the size of a potential tsunami, in real time.

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NEWS EVENTS

Papua New Guinea Earthquakes and Tsunami of 8 February 1987

A major earthquake measuring 7.5 on the Richter scale occurred near Umboi, an isolated island located several miles off the northern coast of Papua New Guinea's main island, on 8 February at about 1834Z time. Its exact epicenter was at Lat. 06.1S and Long. 147.9E.

The island of Umboi was described as devastated, with most of the buildings in the island's administrative center of Sissano destroyed or badly damaged. The earthquake was felt as far away as Port Moresby, 250 miles to the south where tall buildings shook. A number of strong aftershocks followed.

The main quake leveled villages and bridges of this South Pacific island nation leaving more than 3,000 people homeless. The exact death

toll from this event is not known. The Australian Associated Press reported severe damage to homes, roads, water and food supplies, particularly in Umboi which was declared a disaster area. Nearby northern coastal areas were also badly damaged.

A 5 foot tsunami struck the island, but it had been expected and people had moved from low lying areas. The Pacific Tsunami Warning Center (PTWC) reported the magnitude was not sufficient to generate a Pacific-wide tsunami.

Earthquake of 9 January 1987 in Japan

An earthquake measuring 6.9 on the Richter scale rumbled across central and northern Japan. The tremor was centered along the coast of northern Honshu near Morioka, a city of 240,000 people, about 290 miles north of Tokyo. The quake was felt in Tokyo and as far north as Kushiro on the east coast of Hokkaido, Japan's northernmost main island, about 560 miles northeast of Tokyo.

An aftershock measuring 4.6 followed the main quake fifteen minutes later. No tsunami was generated by either quakes.

The Earthquake of 9 January 1987 in Fiji

An earthquake measuring 6.5 on the Richter scale was recorded at 8:02 pm (local time), 9 January 1987, in the vicinity of Fiji. The quake was the strongest to hit the South Pacific area since another 6.5 quake struck there on 17 November 1984. There were no reports of injuries or damage.

Hurricane Strikes the Cook Islands, 3 January 1987

A strong hurricane with winds of 90 mile-an-hour hit the Cook Islands on 3 January 1987, destroying homes, roads and resorts, and leaving as many as 1,000 people homeless on the islands. The main island of Rarotonga was hardest hit by the hurricane's surge which wiped out the main street, destroyed buildings, and severely damaged nearby resorts. Damage was reported to be in excess of $15 million. The analog and digital water level gauge in Rarotonga, which is an official tsunami recording station, were destroyed. Surprisingly the HANDAR platform that records and transmits water level signals to PTWC, although submerged under the water, continued to transmit signals since its antenna survived the hurricane's impact.

The Earthquake of 30 December 1986 in Japan

A powerful earthquake with magnitude of 6.0 shook central Japan on 30 December 1986 causing minor damage and briefly curtailing train service.

No injuries or major damage were reported but the Japanese Meteorological Agency reported that the quake's intensity was high. On the same day, a small volcanic eruption occurred also on a small island near the southern Japanese city of Kagoshima.

Kilauea Eruptions

The volcano of Kilauea, on the island of Hawaii, continued to erupt throughout the early part of December 1986. Lava flows reached the ocean, destroying several homes in the Puna district of the island. Massive amounts of lava continued pouring from Kilauea's east flank, to the sea eight miles away, adding at least 20 acres of new coastline along this southern shore of the island. The volcano which begun erupting in late November was producing about 500,000 cubic yards of lava a day, increasing its flow by December 3, to 780,000 cubic yards a day. The activity of Kilauea is continuing at present, although the volume of lava flows have decreased.

Earthquakes in Taiwan - 15 November 1986

Two strong earthquakes shook Taiwan causing damage in Taipei, triggering rock slides, killing 14 people and injuring dozens more. The earthquake was centered about 100 miles south of Taipei and struck at 5:20 am (local time). Its magnitude measured 6.8 on the Richter scale. A second earthquake, registering 6.3 on the scale, occurred at 7:04 am. The quakes were felt throughout Taiwan, but officials said the hardest hit area were Chungho and Hualien, a resort 180 miles southeast of Taipei, where the quakes triggered rock slides. About 160 aftershocks were registered following the two earthquakes.

Mount Mihara Volcanic Eruption

On 15 November 1986, the volcano, Mount Mihara on Oshima island began rumbling. About a week later on 21 November the volcano started spewing bright orange flames from several openings, including a 600-yard-long fissure on the side of the mountain. Giant plumes of black smoke shot two miles into the sky.

The eruptions were accompanied by hundreds of earthquakes, some of them major tremors. Molten lava flowed towards Motomachi, a town several miles west of Mount Mihara, where one-third of the island's 11,000 population and an undetermined number of tourists lived. Thousands of people were evacuated by more than two dozen ships.

Kermadec Islands Earthquake of 20 October 1986

The largest earthquake to occur since the 19 September 1985 Mexico earthquake, occurred in the vicinity of Kermadec Islands, 750 miles from

New Zealand's North Island. The earthquake had a magnitude of 8.1 on the Richter scale and prompted the Pacific Tsunami Warning Center (PTWC) in Honolulu to issue a regional tsunami watch which was subsequently cancelled. Only a small tsunami of 10 centimeters in height was reported. Also a small tsunami was recorded at a tide gauge on the island of Rapa (Archipelago of Australes).

Earthquake Hits Papua New Guinea, 14 October 1986

An earthquake of magnitude 6.9 on the Richter scale struck Papua New Guinea on 14 October 1986. The epicenter of the earthquake was approximately 500 miles north of Port Moresby and about 1500 miles northeast of Brisbane, Australia, in the vicinity of the New Ireland island area of Papua New Guinea. No reports of damage have been received.

Earthquake of 11 October 1986 in Turkey

A strong earthquake shook western Turkey on 11 October 1986, injuring three people and damaging more than 100 buildings. The earthquake was centered in the Aydin area of Turkey, damaged 150 buildings in the village of Karapunar near the municipality of Kuyacak. According to the Athens Seismological Institute the earthquake had a magnitude of 6.0.

Disastrous El Salvador Earthquake of 10 October 1986

An earthquake occurred on 10 October 1986 in El Salvador causing extensive destruction in El Salvador's capital, killing 976 people leaving 8,176 injured and 31,000 families homeless. According to the U.S. Geological Survey the magnitude of the earthquake was 5.4 on the Richter scale, and struck at 1:40 pm EDT, 11:40 am Salvadoran time. A second tremor registering 4.5 struck at 2:04 EDT. Hundreds of strong aftershocks were felt in the hours and days following the main quake. Damage was estimated at $2 billion.

The Earthquake of 13 September 1986 in Greece

An earthquake measuring 6.2 on the Richter scale struck the Kalamata region of Greece at 10:27 pm (local time) knocking out electricity, wrecking scores of homes, killing at least eight people, injuring 300 and entombing at least 20 others. Of the 300 injured people, 70 were injured seriously and the death toll was expected to rise. The earthquakes had their epicenter in the Ionian Sea southwest of Kalamata. Numerous aftershocks rattled the city of 80,000 located about 110 miles southwest of Athens. The main earthquake damaged hundreds of buildings, including the city hall, police headquarters, the city's hospital, and the residence of the governor of Kalamata Province.

California Earthquake of 21 July 1986

A severe earthquake with magnitude of 6.1 struck at 7:42 am (local time) the White Mountains region 240 miles north of Los Angeles, California. The earthquake swayed buildings as far away as Las Vegas, Nevada and Salt Lake City, Utah. An aftershock with magnitude 5.2 occurred nine minutes later. The epicenter was centered 15 miles north of Bishop, California. Damage was not great because of the low population density of the area. Twenty homes were reported wrecked at Bishop from the earthquake which cut off the town's water, opened ground fissures and triggered numerous rock slides in the High Sierra. No fatalities or serious injuries were reported.

California Earthquakes of 8 and 13 July 1986

An earthquake measuring 5.3 on the Richter scale was recorded at 6:46 am (local time) on 13 July 1986. The earthquake's epicenter was 28 miles southwest of Oceanside in the Pacific Ocean. Oceanside is located 75 miles southeast of Los Angeles. Besides Oceanside the quake was felt along a 150-mile stretch of the coast from San Diego to Oxnard, and as far away as Yuma, Arizona, 160 miles east of San Diego. This was the second big earthquake to rumble through the region in six days, and the largest recorded quake in recent times in the immediate area offshore from the San Diego metropolitan area. The previous record in that area was a magnitude 4.3 earthquake which occurred on July 7, 1984. Fifteen people were injured.

The week before, on Tuesday, 8 July 1986, an earthquake with magnitude 5.9 occurred approximately 12 miles northwest of Palm Springs causing an estimated $5.75 million damage and injuring 40 people. Numerous aftershocks were recorded in the area following the main event, the strongest having a magnitude of 4.5.

Disastrous Ecuador Earthquakes of 5-6 March 1987

A series of earthquakes on March 5 and 6 struck the Napo province of Ecuador, a jungle area 175 kilometers northeast of Quito. The earthquakes set off a series of landslides that entombed entire villages, buried sections of the road and cut Napo off from the rest of Ecuador. The earthquake wrecked a 50-kilometer segment of the country's key oil pipeline, halting oil production and export. The death toll climbed over 1,000 with many more missing. However, the real number of dead and missing may never be known as widespread destruction occurred in the eastern jungles, from flooding, mudslides, and landslides. The chief administrative official of the region, Jorge Gonzalez, said that the final death toll may never be known because many settlements are in isolated area. He estimated as many as 2,000 people may have been killed in his province and he said 5,000 were missing.

Launching of GOES Satellite

A Geostationary Operational Environmental Satellite (GOES) has been launched to a stationary orbit 22,300 miles above the equator over Colombia to monitor the earths weather in the Caribbean and Atlantic. This was a critically needed weather satellite used to track hurricanes and transmit important data. As a result of this launching the old GOES satellite that transmits important tsunami and water level data, will be moved west on an equatorial orbit over the Pacific. This move of the old GOES will result in much better coverage of the Pacific.

INTERNATIONAL TSUNAMI INFORMATION CENTER

Visiting Scientists Training Program

As of 21 November 1986, Ing. Sergio Hernandez and LTK. Sofjan Rawi, from Guatemala and Indonesia respectively, completed their 6-week Visiting Scientists Training Program at ITIC. The training these visiting scientists received was comprehensive. In addition, the visiting scientists had a thorough introduction on all aspects of the tsunami problem, and worked on specific problems related to tsunami warning in their own country and on improvements of communications.

The 6-week IOC-sponsored visit to ITIC and the Pacific Tsunami Warning Center was a rewarding experience not only for the scientists but for the staff of ITIC and PTWC and for the rest of the people that worked with them. The training and the exchange of ideas which resulted from this visit should have positive benefits to the Tsunami Warning System.

LTK. Sofjan Rawi

Ing. Sergio Hernandez

Tsunami Watches and Warnings to Pitcairn Island

ITIC has communicated with Mr. G. D. Harraway of the Office of the Governor of Pitcairn Island and with Mr. J. Elder of the New Zealand Office of Civil Defense regarding the inclusion of Pitcairn Island in the dissemination of tsunami warning bulletins. The remaining problem is one primarily of communications.

Present communications are via radio telephone service to New Zealand which are operated intermittently, leaving long periods during which there may not be communications between Pitcairn and New Zealand and therefore, information about an impending tsunami may not be transmitted to Pitcairn in time to be of usefulness.

ITIC reviewed historical tsunami data and determined that a tsunami generated from the Peru-Chile region could be the most potentially threatening event for Pitcairn.

In the absence of other alternate communications, ITIC suggested the following:

1. A program of public education on tsunami preparedness and some familiarity with the tsunami phenomenon. For example, there are certain indicators of tsunami arrival which could be observed by people near the sea, such as withdrawal of the water prior to tsunami arrival. Such withdrawal may start as early as 10 to 15 minutes before a significant tsunami hits the Island, and that may be adequate indication for people near the shore to evacuate to higher ground.

2. A more frequent communication schedule with New Zealand, perhaps 4 times daily at 6 hour intervals. Assuming that travel time of a potential tsunami to Pitcairn from the Peru-Chile area is 8 to 8 1/2 hours, 6-hour communication interval could give as much as 2 to 2 1/2 hours early warning to Pitcairn. Of course there is very little that can be done for locally generated tsunamis. However, local tsunamis are extremely rare.

ITIC provided some educational materials related to tsunamis to assist with the island's program of tsunami public awareness.

Tsunami Glossary

One of the recommendations of the Tsunami Workshop held in Sidney, Canada in July 1985, was that a tsunami glossary should be prepared. Since then, ITIC has made considerable progress in the development of a preliminary glossary of tsunami related terms. This draft glossary will be made available at the XI Session of ICG/ITSU in Beijing, in September 1987 for review and comments.

Tsunami Workshop Proceedings

ITIC is presently finalizing the editing of the Proceedings resulting from the International Tsunami Workshop held in Sidney, Canada, July 29 - August 1, 1985. Once completed, these Proceedings will be forwarded to the Secretariat of the Intergovernmental Oceanographic Commision (IOC) for publication.

ITIC Review of Tsunami Event Map

At the request of Mr. Desmond P.D. Scott, Deputy Editor of the International Geological/Geophysical Atlasses of the Atlantic and Pacific Oceans (GAPA), ITIC made a preliminary review of the Tsunami Event Map proposed for inclusion in the Atlas. The Tsunami Event Map has been prepared by Drs. Go, Kaystrenko, Simonov and Soloviev, and represents a thorough and significant compilation of historic tsunami information.

Drs. Talandier and Okal Visit PTWC and ITIC

Dr. J. Talandier and Professor E. Okal visited ITIC and PTWC, following a conference on volcanoes they attended on the island of Hawaii in January. Dr. Talandier is Director of the Geophysical Laboratory in Tahiti, and Dr. Okal is professor of seismology at Northwestern University. Their visit at ITIC and PTWC was very productive and will result in positive benefits in the exchange of seismic data, and particularly in providing PTWC in real time with seismic moment measurements which Dr. Talandier is able to determine in Tahiti with broad band seismic instrumentation. A novel method for quickly estimating the seismic moment has been developed and recently reported by Drs. Talandier, Okal and Raymond.

Visitors to ITIC

Taeko Ishihara	Japan
Mr. & Mrs. Pologruto	Ambler, Pennsylvania
Bob Iversen	Kaneohe, HI
Doug Medeiros	Honolulu, HI
Richard Ching	Vending Facilities Specialist, Ho'Opono Services for the Blind
Roxanne Rice-Barth	Honolulu, HI
Gale Yokemura	Honolulu, HI
Phyllis Kaplan	Honolulu, HI
Margaret Roadville	Honolulu, HI
B. Cockert	Honolulu, HI
Sergio Hernandez	Engineer/Hydrologist, Guatemala
Barbara J. Lindsey	Hawaiian Airlines
Barbara Zachary	Honolulu, HI

John Finch	Honolulu, HI
Zhou Qinghai	HIG, University of Hawaii
Safran Rawi	Head of Underwater Safety & Technology Section, Jakarta, Indonesia
Mike Hoewacheid	Disaster Preparedness Coordinator, COMNAVBASE Pearl Harbor
Michael Alward	Civil Air Patrol, Honolulu, HI
Gordon B. Dawson	Technical Advisor, Apia Observatory, Western Samoa
Xu Suya Qinghai	Beijing, China
Prof. Emile A. Okal	Assoc. Prof., Northwestern University
Dr. J. Talandier	Director, Laboratoire Geophysique, Tahiti, French Polynesia
Mickey K. Moss	Pacific Operations Gp., NOS-NOAA
Bennett & Colette Siu	Science Fair Research
Jeff & Cori Weston	Middletown, New Jersey
Prof. Akira Saito	Tokai University, Japan
J.J. Lewandowski	Operations Off., U.S. Navy
R.R. Black	Civil Defense Commissioner, Ministry of Civil Defense, New Zealand
Gregory Girard	Consultant, Arthur D. Little, Inc.
Dr. Floyd McCoy	Lamont Observatory, Columbia University

Nancy Chiu Leaves ITIC

Nancy Chiu, Librarian for ITIC left the Center in July 1986 and has relocated in San Francisco, where she is now Librarian for the San Francisco Public Library. Nancy worked for ITIC since June 1985 and during her tenure was responsible for organizing the ITIC library holdings and the tsunami historical files.

IOC — ITSU

ITSU XI - Beijing, China, 8-12 September 1987

The Eleventh Session of the International Coordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU) is scheduled to take place 8-12 September 1987 in Beijing, China. An annotated provisional agenda is being drafted presently by the IOC Secretariat, to be circulated to national contacts of ITSU Member Nations. Once it is finalized, ITIC will publish it in a future issue of the Newsletter.

Fourteenth Session of the IOC Assembly, 17 March - 1 April 1987

The Fourteenth Session of the IOC Assembly took place in Paris at the UNESCO headquarters 17 March to 1 April 1987. A list of scheduled meetings of the Intergovernmental Oceanographic Commission and of the Division of Marine Sciences of UNESCO was circulated for the benefit of the Member States.

IOC Meeting on Ocean Mapping

The Intergovernmental Oceanographic Commission (IOC) held the Second Session of its Consultative Group on Ocean Mapping in Paris, France, on 12-13 February 1987. The session was opened by the Chairman of the Group, Mr. Desmond P.D. Scott, and the Secretary of IOC, Dr. Mario Ruivo. The session reviewed intersessional ocean mapping activities and received reports from the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO); from the Central Editorial Board for the Geological/Geophysical Atlasses of the Atlantic and the Pacific Oceans (GAPA); from the Editorial Board for the International Bathymetric Chart of the Mediterranean (IBCM); and from the Editorial Board for the International Bathymetric Chart of the Caribbean Sea and part of the Pacific Ocean off Central America (IBCCA). The Group reviewed other proposed IOC regional mapping projects of the Western Indian Ocean (IBCWIO), the Red Sea and Gulf of Aden (IBCRSGA), the Central Eastern Atlantic (IBCEA), and other projects. A summary report on the meeting has been published by IOC.

IOC Working Committee on International Oceanographic Data Exchange

The Twelfth Session of the IOC Working Committee on International Oceanographic Data Exchange took place in Moscow, USSR, 10-17 December 1986. A summary report of the session has been published by the IOC Secretariat.

Third Session of STAR, 2-3 September 1986

The Joint CCOP/SOPAC - IOC Working Group on South Pacific Tectonics and Resources (STAR) held its third session in Rarotonga, Cook Islands, on 2-3 September 1986. A summary report of the meeting has been published by the IOC Secretariat.

SEATAR Meeting

The Twelfth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources (SEATAR) was held in Singapore 22-23 August 1986. CCOP stands for Committee for Co-ordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas. IDOE stands for the International Decade of Ocean Exploration. The Twelfth Session dealt with intersessional activities and a review of the SEATAR on-going and future projects. The IOC Secretariat has published a summary report on the meeting.

List of National Contacts of ICG/ITSU

The following is a list of National Contacts of ITSU members on file in the ITIC office. Please inform ITIC if there are any changes.

Australia	Mr. P. F. Noar Assistant Director (Services) Bureau of Meteorology GPO Box 1289 K Melbourne, Victoria 3001 Australia
CANADA	Mr. W. J. Rapatz Regional Tidal Superintendent Institute of Ocean Sciences Dept. of Fisheries and Oceans P. O. Box 6000 Sidney, B. C. V8L 4B2, Canada
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CHINA	Mr. Luo Yuru Director National Bureau of Oceanography of the People's Republic of China Beijing, China

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KOREA (DPR OF KOREA)	Mr. Jong Young Gu National Oceanographic Commission Hydrometeorological Service P.O. Box 100 Pyongyang Democratic People's Republic of Korea
KOREA (REPUBLIC OF)	Mr. Myong Bok An Director of Weather Forecasting Korean Meteorological Service 1 Songweol-dong, Chongro-ku Seoul, 110 Korea
MEXICO	Lic. Ma de los Angeles Lopez-Ortega Ministro Consejero Encargada de Negocios a.i. UNESCO Delegacion Permanente de Mexico 1, Rue Miollis 75732 Paris, France
NEW ZEALAND	Dr. Alex E. Gilmour Dept. of Scientific & Industrial Research New Zealand Oceanographic Institute Private Bag Kilbirnie Wellington, New Zealand
PERU	Contralmirante Jorge A. del Aguila Sanchez Direccion de Hidrografia y Navegacion de la Marina Casilla Postal No. 80 Gamarra No. 500 Chucuito, Callao, Peru
PHILIPPINES	Mr. Conrado M. Santos Chief Geophysicist Physical Science Division Bureau of Coast & Geodetic Survey 421 Barraca St. San Nicolas, Manila, Philippines
SINGAPORE	Mr. Paul Lo Su Siew Director Meteorological Service Singapore P. O. Box 8 Singapore Changi Airport Singapore 9181, Republic of Singapore
THAILAND	Commander Thanom Charoenlaph Hydrographic Department Royal Thai Navy Bangkok 6, Thailand

UNITED KINGDOM (HONG KONG)	Mr. Patrick P. Sham Royal Observatory, Hong Kong 134A Nathan Road Kowloon, Hong Kong
USA	Mr. Richard H. Hagemeyer Director National Weather Service, Pacific Region P. O. Box 50027 Honolulu, Hawaii 96850-4993 USA
USSR	Dr. B. P. Khimitch Chief, Arctic and Antarctic Department USSR State Committee for Hydrometeorology and Natural Environmental Control 12, Pavlik Morozov Per. Moscow 123376 USSR
WESTERN SAMOA	The Superintendent Apia Observatory Private Mail Bag Apia, Western Samoa
Director, ITIC	Dr. George Pararas-Carayannis Director International Tsunami Information Center P. O. Box 50027 Honolulu, Hawaii 96850-4993 USA (Cable Address: ITIC HONOLULU)
Chairman, ICG/ITSU	Ing. Eddy H. Sanchez Benett Instituto Nacional de Sismologia Vulcanologia, Meteorologia e Hidrologia Ministerio de Comunicaciones Transporte y Obras Publicas 7a Avenida 14-57 Zona 13 Guatemala, C.A.

NATIONAL AND AREA REPORTS

USSR to Host International Tsunami Symposium in 1989

In February 1987, Prof. S. L. Soloviev of the Institute of Oceanology in Moscow, USSR announced their hosting of an International Tsunami Symposium at Novosibirsk, USSR, in August 1989. The one week

symposium will serve as an intersessional meeting of the International Union of Geodesy and Geophysics. Historically, about 100 tsunami scientists attend these symposia.

PTWC - Royal Observatory Exchange of Software

The Pacific Tsunami Warning Center (PTWC) in Honolulu has provided the Royal Observatory, Hong Kong, with recently developed computer software on earthquake epicenter determination and magnitude computations. The operational advantage of this software lay on the fact that no initial epicenter estimate is required, but automatically computes a series of possible solutions on a world-wide basis and then selects the best fit based on minimal station residuals. The method also provides additional information, such as arrival times of main seismic phases at certain stations, epicenter location relative to major cities, and elapsed time since the earthquake origin.

Exchange of Tsunami Scientists - USA/China

The People's Republic of China and the United States of America will continue their profitable exchange of tsunami scientists this May when the PRC hosts three scientists from the USA. Dr. Harold G. Loomis, Professor of Ocean Engineering from the University of Hawaii at Manoa, Dr. Walter C. Dudley, Associate Professor of Marine Geology and Oceanography from the University of Hawaii at Hilo, and Mr. Richard L. Sillcox, Geophysicist at the Pacific Tsunami Warning Center, will meet with colleagues at the National Marine Environmental Forecast Center in Beijing, as well as several other research and operational scientific centers in Beijing and coastal cities in China. The operational benefits of these exchanges to the Tsunami Warning System in the Pacific have already proven themselves. The future holds the promise of continued operational system enhancements, in addition to which may now be added the benefits of cooperative research exchanges.

This is the second exchange of this type between the USA and the PRC. In August of 1985, Mr. Yang Huating and Mr. Zhou Qinghai from the National Marine Environmental Forecast Center met with the Director of the International Tsunami Information Center, colleagues at the Pacific Tsunami Warning Center, scientists at the University of Hawaii, and the staff of the U.S. Regional Warning Center in Palmer, Alaska. During their visit Mr. Yang and Mr. Zhou also attended the Tenth Session of ICG/ITSU in Sidney, Canada.

Exchange of Tsunami Scientists - USA/USSR

A two-week exchange has been approved involving the exchange of two scientists from USA and USSR. The two-week exchange involves Mr.

T. Sokolowski of the Alaska Tsunami Warning Center in Palmer, Alaska and Dr. V. Gusiakov of the tsunami program at the Novosibirsk Computing Center in Novosibirsk, USSR. The purpose of the exchange is to share techniques in the real time assessment of the tsunami potential of a large earthquake. Mr. Sokolowski has developed real time processing programs on small computers while Dr. Gusiakov has investigated the use of certain seismic signals generated by large earthquakes that may serve as an indicator of a tsunamigenic earthquake. The exchange will take place in April and May 1987.

Progress in Tide Gauge and Seismograph Instrumentation in Mexico

Dr. Salvador F. Farreras, Tsunami Research Oceanographer at Centro de Investigacion Scientifica y de Education Superior de Ensenada (CICESE), has informed ITIC regarding progress made by the Center in establishing tide gauge and seismograph instrumentation and improvements in communications. Mr. Richard Hagemeyer, USA National Contact and Mr. Gordon Burton, Geophysicist-in-Charge of the Pacific Tsunami Warning Center (PTWC) in Honolulu, have been informed of the new instrumentation and communications at CICESE. With the information provided by Dr. Farreras, an exchange of data and information between CICESE and PTWC has been established, which is of great value to both Centers and to tsunami preparedness in Mexico. The data from the improved CICESE tidal and seismic networks will be of great value to improving the operational capability of the Tsunami Warning System in this part of the Pacific. ITIC has provided to Dr. Farreras copies of the Wave Reporting Procedures, Communications Plan and other materials.

HANDAR Installations

Several HANDAR Platforms have been operating in the Pacific from which the Pacific Tsunami Warning Center (PTWC) in Honolulu receives data for tsunami warning purposes. Recent installations were made at Easter Island, Caldera, Arica, and Soccorro Island, increasing the number of total HANDAR installations operating in the Pacific to 26. Another installation is pending for San Felix Island, Chile.

The deployment of HANDAR platforms for tsunami warning purposes and for sea level studies has been a major breakthrough in the improvement of the Pacific Tsunami Warning System. The platforms transmit in real time via geosynchronous satellites important sea level information which is vital to studies of sea level, ocean circulation and climatic effects, as well as for the assessment of potential tsunamis in the Pacific Ocean.

Democratic People's Republic of Korea - ICG/ITSU Membership

In the last issue of the ITIC Tsunami Newsletter it was announced that as of June 1, 1986 the Democratic People's Republic of Korea

joined the International Coordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU). Mr. Jong Young Gu of the National Oceanographic Service was designated as the National Contact.

ITIC contacted Mr. Jong Young Gu and provided information, materials and publications related to the Tsunami Warning System. Arrangements also are being made to establish communications between PTWC and the Hydrometeorological Service and to test these communications so that tsunami data, and watch and warning information can be exchanged. ITIC is coordinating the effort in initiating a communication test, and the establishment of tidal stations in DPR of Korea as official tsunami stations.

International Centre for Ocean Development

The following report was received from Dr. Gary C. Vernon, President of the International Centre for Ocean Development (ICOD) which was established as a Canadian Crown Corporation in February 1985.

"In the year since the organization's inception, a number of its objectives translated into projects. In the Caribbean basin, the Technical Assistance Division has supported the establishment of a fisheries support unit within the regional Organisation of Eastern Caribbean States (OECS). A Canadian specialist in monitoring and surveillance of foreign fisheries activities has been provided to assist the South Pacific Forum Fisheries Agency in the development of regional surveillance activities in the South Pacific.

ICOD has also been active in the "person-to-person" aspect of ocean development. In Vanuatu, ICOD is involved in the provision of direct assistance to artisanal fishermen at the village level. Training for fishermen has been provided at fisheries colleges in Canada, and investigations are being undertaken for a permanent programme to utilize Canadian fishermen in village-level extension programmes overseas.

The ICOD Training Division is active in a number of areas. Major scholarship programmes have been initiated, including the granting of 44 scholarships to students from 17 countries for graduate level study at Canadian institutions over the past two years. Further assistance is being provided for students attending the World Maritime University in Sweden, the International Ocean Institute "Training Programme in Management of the Exclusive Economic Zone," and students attending regional universities within the South Pacific and Caribbean.

ICOD has also cooperated with the World Maritime University to prepare materials for, and deliver, a two-week multidisciplinary course for marine affairs policy makers. The Centre is cooperating with other agencies as well in the preparation of several short courses including offshore mineral exploration, ocean boundary making, sea use planning, and fisheries stock assessment which will be offered in developing regions. Discussions have been initiated with

francophone and anglophone Canadian universities to develop a one-year diploma programme in Marine Affairs which will provide an intensive course in ocean management for decision makers in government and industry from developing states. In addition to financial support for the development of this programme, 20 scholarships per year will be awarded to support the attendance of students from developing countries.

ICOD's activities in the field of information are aimed at providing useful relevant materials to developing countries as well as building systems whereby national and regional organizations can collect and share information from their own sources. Currently, ICOD's Information Services are funding distribution to governments and institutions abroad of a Marine Affairs Bibliography published quarterly by Dalhousie University. The Centre also has undertaken compilation of a directory of marine-related training resources in Canadian universities, government and private institutions for distribution abroad. In cooperation with the World Food Day Association, a World Fisheries Map with an accompanying teacher's guide has been prepared for use in schools to demonstrate the role of fisheries for the world economy.

With regard to the building of information systems, ICOD is supporting the development of a regional Caribbean fisheries data base to be managed by the fisheries support unit of OECS. Support for regional information centres in the South Pacific and the Indian Ocean is currently under consideration.

In the coming years, ICOD intends to expand its activities in the Caribbean Basin, South Pacific, West Africa and the Indian Ocean, and to further cooperate with institutions and agencies in the developing world."

National Contact for New Zealand

The IOC Secretariat and ITIC have been informed by the New Zealand Oceanographic Institute that Dr. Alex Gilmour has assumed the position of Tsunami National Contact for New Zealand that was previously held by the late Mr. Norman Ridgway.

Professor Kajiura Retires

Professor Kinjiro Kajiura, prominent scientist at the Earthquake Research Institute of the University of Tokyo retired as of March 31, 1986. Some of his work has been published in a special volume by the University of Tokyo. Professor Kajiura is well known for his contributions to tsunami research. We wish Professor Kajiura good health and happiness in his retirement years.

Pacific Tide Party Completed Inspection of Tsunami Stations in Alaska

The Pacific Tide Party completed in the third quarter of 1986 inspections of tide gauges and tsunami stations in Adak, Unalaska, Sand Point, Sitka, Kodiak, Seward, and Yakutat.

In the first quarter of 1987, inspections were completed at Truk Atoll, Johnston Island, Crescent City, Kahului, Honolulu, Kwajalein, Pago Pago, Nawiliwili, Wake Island, Midway Island, Guam, and Hilo.

Japanese Researcher Visits the ATWC

Dr. Yukio Inoue, a tsunami research specialist from Mitsubishi Research Institute, Inc. (MRI) visited the Alaska Tsunami Warning Center (ATWC) in Palmer, Alaska on December 22, 1982. The MRI is one of Japan's leading private professional research organizations which was founded in 1970 for the purpose of establishing an advanced think-tank to meet Japan's needs in a post-industrial information society. It consists mainly of research and consulting departments, and has a research work force of 600 personnel that are involved in the three main broad areas of research and development, systems development, and information processing.

It is interesting to note the many areas of MRI involvement. The research and development areas cover domestic and international economic forecasting, corporate management planning, industrial structure, consumption analysis, regional development, and industrial technologies. In systems development, engineers, and computer scientists work in aerospace, nuclear power, environmental assessments, earthquake and tsunami hazards, operations research, and business management systems. Lastly, information processing concerns a major computer center (IBM3081's and CRAY-1) for processing scientific and engineering calculations and serving as computer consultants for industry and government.

Dr. Inoue's speciality is in tsunami computer systems development and analysis. He was sent by MRI to learn about the ATWC operations, procedures, and to view the ATWC's automatic earthquake processing system. During his visit, he was given a tour of the facility, and the ATWC staff explained the hardware configuration, seismic and tide networks, procedures, software, output images, interactive system, community preparedness, telemetry circuits, and the current and future technique development directions.

Alaska Tsunami Warning Center

The following article was provided by the Alaska Tsunami Warning Center:

Tsunami Warning - Fox Islands Earthquake, February 1987

On February 26, 1987, a large earthquake occurred at 11:32 pm (AST) in the Fox Islands, Alaska. The event was located about 50 miles southwest of Unalaska (about 1000 miles southwest of Palmer), was sized as a magnitude 6.9, and an immediate warning issued. This event's location and size were nearly identical to the one that occurred on July 2, 1965 which produced a local tsunami. It should be noted that this event occurred about 220 miles from the 1946 event (magnitude 7.4) which generated a devastating local and Pacific-wide tsunami, and was the impetus for creating the present-day Tsunami Warning System. Fortunately, this earthquake was not a repeat of the 1946 event.

This earthquake occurred along a subduction plate boundary in the Fox Islands area, where the Pacific plate moves in the northwesterly direction at about 8cm/year, impacts and dips underneath the North American plate. The movement of the Pacific plate crustal material continues its journey towards assimilation with upper mantle material. This movement is not continuous and uniform with plate interlocking in some areas more than others. Depending upon the size of the locked area and length of time that the areas have been locked, a resurgence of plate movement can result in a major devastating earthquake. For an event like this one, the crustal adjustments (aftershocks) in the immediate and surrounding areas will continue for a few weeks.

When a large or major event occurs near a coastal area, it is not immediately known if a tsunami has been generated and must be considered as potentially tsunamigenic. Unfortunately, one cannot immediately determine the area of fracture, direction of the fault movement (vertical, horizontal, or some combination), and the amount of sea floor movement energy transferred into tsunami energy. Therefore, the ATWC issues an immediate warning which is based upon the size of an event which reflects the event's potential for tsunamigenesis. For this event, a tsunami warning was being issued to the recipients 11 minutes after the origin time of the earthquake which is an exceptionally good response time for issuing a warning. (Normally, the issuance of a warning for an event in this area should take about 15-20 minutes from the origin time.) It should also be noted that the last two response times for issuing warnings were 8 and 12 minutes. Some of the main reasons for these exceptionally good responses in issuing the last 3 warnings are the ATWC staff teamwork, effective development techniques and concepts, effective procedures, staff practice sessions, functioning computer and equipment, a lot of hard work, and the continued support given by the Alaska Regional Headquarters to accomplish our higher and higher goals. It should be noted that to achieve response-consistency, more development and refinement are necessary after we have converted the present developments to our intended new computer system.

The first warning bulletin placed the areas from Attu to Kodiak in a warning status, and the remainder of the Alaskan coast, British Columbia, Washington, Oregon, and California, in a watch status. During this time, people were evacuated from low lying coastal areas. The nearest tide recorder, about 70 miles from the epicenter, was being monitored when the trace went off-scale (and remained there) about 15 minutes prior to the expected arrival of a tsunami at Unalaska. The staff contacted the Unalaska Police, tide observer, and ALASCOM to find out what had happened (power loss, a devastating tsunami, or equipment failure). We learned that the cannery shut off the power to minimize fire. The Unalaska Police (and others) monitored water levels and reported no unusual wave activity.

Upon confirmation that no tsunami was generated, the warning/watch was immediatly cancelled. Later people reported that the earthquake had "jostled them," "shook for a long time," and "items were knocked from shelves." A ship captain, whose ship was tied to a dock, thought that his ship was rammed by another one as the earthquake shoved the dock against the ship. After realizing it was an earthquake, he immediately went out to sea -- exactly the response we elicit in our community preparedness program. It should be noted that George Carte (with ADES) visited many communities in and about that area during the fall of 1986.

For the next several weeks, we expect many aftershocks to occur as the crustal material seeks equilibrium. As is usual during and immediately after these events, the ATWC was inundated with telephone calls from officials, media, and the general public. These events also generate many visitors to the ATWC facilities.

ANNOUNCEMENTS

28th International Geological Congress - July 1989

The 28th meeting of the International Geological Congress will be held in Washington, D.C., July 9-19, 1989. The meeting, hosted by the U.S. National Academy of Sciences and the U.S. Geological Survey, will mark the first time the Congress has met in the United States since 1933.

The meeting will include symposia, technical sessions, and poster presentations covering the latest developments in all the basic and applied earth sciences. In addition, interdisciplinary symposia will reflect growing requirements for broadly based approaches to many earth science problems. More than 40 short courses and workshops will be offered by the Congress. These will cover a spectrum of fields and topics and will provide up-to-date information and training in critical areas.

A large area will be provided for exhibition of state-of-the-art technology for the broad range of earth sciences. Exhibits will be organized to demonstrate the integration of technology with the substance of scientific research.

In addition, approximately 100 pre- and post-Congress field trips are being planned throughout the United States, including Alaska and Hawaii.

For more information write to:

Dr. Bruce B. Hanshaw
Secretary General
P.O. Box 1001
Herndon, VA 22070-1001
USA

PACON 88

The Pacific Congress on Marine Science & Technology (PACON 88) will be held in Honolulu, Hawaii on May 16-20, 1988. PACON 88 has numerous society and organization sponsors, including among many others, the Tsunami Society, the IUGG Tsunami Commission, the UNESCO-Division of Marine Sciences, the IOC Secretariat and ITIC. A more detailed announcement will be included in a future issue of the ITIC Newsletter.

For more information on the Conference write to:

PACON 88
c/o Sea Grant College Program
University of Hawaii
Honolulu, HI 96822
USA

PACON 88 - Tsunami Workshop

The third Pacific Congress on Marine Science & Technology (PACON 88) will be held in Honolulu from May 16 to 20, 1988. A half-day Tsunami Workshop is planned for May 20. You are cordially invited to submit a paper for presentation at this workshop. Please send the title of your paper to the following address no later than June 30, 1987.

Dr. T. S. Murty
Institute of Ocean Sciences
Department of Fisheries and Oceans
P.O. Box 6000
Sidney, B.C., V8L 4B2, Canada

Pacific Telecommunications Conference (PTC'88)

The 10th annual Pacific Telecommunications Conference will be held on February 15-18, 1988 in Honolulu. The theme of the Conference is Telecommunications and Pacific Development: Alternatives for the Next Decade." The Conference is organized to

1. Review the past 10 years of telecommunication changes in the region and provide an assessment of the current situation;

2. Project the telecommunication requirements, usage, impacts, plans, alternatives and changes over the next 10 years; and,

3. Examine the roles of consultants, governments, regional and international organizations in the telecommunications development process.

Papers are requested which address one of these three general categories. Papers should focus on some aspect of telecommunications, including developments in data communication; satellite communication; fiber optics; use of telecommunication in manufacturing, health, education, and finance, etc.; standards; training; new technologies; policy matters; and social impacts.

The deadline for submission of papers is June 30, 1987. For more information write to:

PTC'88
1110 University Ave., Suite 308
Honolulu, HI 96826
USA

OCEANS 87

A Conference on Oceans is scheduled to take place on 28 September - 1 October 1987, in Halifax, Nova Scotia, Canada. The "Oceans 87" Conference theme is "The Ocean - An International Workplace." Oceans 87 Technical Program is chaired by David McKeown of the Bedford Institute of Oceanography.

The Marine Technology Society and the Institute for Electrical and Electronics Engineers/Oceanic Engineering Society will sponsor the Oceans '87 Conference and Exposition, to be held concurrently with the 5th Working Symposium on Oceanographic Data Systems, sponsored by the IEEE Computer Society, Technical Committee on Oceanic Engineering and Technology.

The Oceans '87 theme: "The Ocean - An International Workplace," is intended to highlight the worldwide co-operative aspects of ocean

engineering. Papers will address a variety of viewpoints regarding international developments in science and technology and their environmental, sociological, and political implications. The conference is designed to be a forum for formal and informal meetings of scientists, engineers, educators, manufacturers, service organizations, public officials and environmentalists.

For more information write to:

Oceans '87
c/o Mr. H. B. Nicholls
Bedford Institute of Oceanography
P.O. Box 1006, Dartmouth
Nova Scotia, Canada B2Y 4A2

XVI Pacific Science Congress - August 1987

The XVI Pacific Science Congress sponsored by the Pacific Science Association and the National Academy of Sciences of the Republic of Korea will be held in Seoul, Korea, August 20-30, 1987. The main theme of the Sixteenth Congress is "New Dimensions of Science, Manpower and Resources in the Pacific." Three general symposia are being planned to cover this broad topic.

1. Development of Science and Technology in the Pacific.
2. Population and Food in the Pacific Basin.
3. Prospect on the Major Resources of the Pacific Region.

An additional 15 sections are being organized by the Scientific Committees of the Association. For more information on the XVI Pacific Science Congress write to:

Pacific Science Association
P.O. Box 17801
Honolulu, HI 96817
USA
Cable: PACSCIENCE, Honolulu
Phone: (808) 847-3511

IUGG Tsunami Symposium, 18-19 August 1987

In conjunction with the International Union of Geodesy and Geophysics (IUGG) General Assembly, in Vancouver, Canada, the Tsunami Commission of IUGG will hold a Tsunami Symposium on August 18 and 19, 1987. The deadline for submitting abstracts was February 15, 1987. Three half-day sessions are planned. The business meeting of the Tsunami Commission will take place on the afternoon of August 19. Tsunami Commission members as well as non-members are invited to

attend the business meeting (only members can vote). Elections will be held for all positions of the office bearers.

For more information write to:

Dr. T. S. Murty
Chairman, IUGG Tsunami Commission
Institute of Ocean Sciences
P.O. Box 6000
Sidney, B.C., V8L 4B2, Canada

ORIA 87

A conference on Artificial Intelligence and the Sea will be held in Marseilles, France on 18 and 19 June 1987. The objective of this second ORIA Conference is to show, through real applications, that actual developments in Artificial Intelligence and specially in the area of expert systems are out of laboratories. They are now in the industrial world, particularly in the sea linked business such as offshore, ship building, fishing, harbours, installations, etc. The conference will also deal with the state of the art and different tools available in the area of robotics for present applications in the sea. An exhibition will be held also of industrial products and prototypes involved in computer hardware and software.

For more information write to:

ORIA 87
International Institute of Robotics and
Artificial Intelligence of Marseilles
CMCI/2, Rue Henri-Barbusse
13241 Marseille cedex 1, France

Phone: 33.91.36.72
Telefax: 33.91.91.70.24
Telex:.. MISTEL 440.860 F

Cordilleran Section, GSA, 83rd Annual Meeting - May 1987

The Cordilleran Section of the Geological Society of America will hold its 83rd Annual Meeting on May 20-22, 1987 at the University of Hawaii at Hilo. This meeting will be held jointly with the Paleontological Society, Pacific Coast Section. A number of specialized symposia are anticipated on a number of geological topics, including one on Geological Hazards and Monitoring. A number of field trips have also been scheduled to volcanoes of Hawaii and other scientific attractions of Hawaii including a visit to the Mauna Kea volcano and to the Astronomical Complex at its top. The deadline for the submission of abstracts was December 29, 1986.

Further information on the meeting can be obtained by writing to:

Richard Hazlett
Dept. of Geology/Division of Natural Sciences
University of Hawaii at Hilo
Hilo, Hawaii 96720-4091
USA

Offshore Technology Conference, 27-30 April 1987

The Offshore Technology Conference (OTC) is scheduled to take place at the Houston Astrodomain in Texas, USA, on April 27-30, 1987. The OTC 87, as it is abbreviated coincides with the Twelfth World Petroleum Congress which convenes also in Houston from April 25 to May 1. OTC 87 has numerous technical sessions in its program schedule dealing with a variety of topics on all aspects of ocean technology. A technical exhibition will be also held in the Astrodomain where a number of products and services encompassing more than 230 categories in ocean technology will be presented.

For more information write to:

OTC 87
P.O. Box 833868
Richardson, Texas 75083-3868
USA

Coastal Zone 87

The Fifth Symposium on Coastal and Ocean Management will be held on May 26-29, 1987 in Seattle, Washington, USA. Coastal Zone 87 is a multidisciplinary conference on comprehensive coastal and ocean management for professionals, citizens, and decision-makers who will join in an exchange of information and views on matters of regional, national and international interest and scope.

The Symposium has the broad purpose of diffusing technical knowledge and current practice for the improvement of planning, design, development, and conservation actions related to our coasts and oceans. This year's theme is entitled "Spotlight on Solutions," emphasizing a recurrent focus on practical problem solving.

Coastal Zone 87 topics will include science and engineering; data gathering and monitoring; law and politics; planning, conservation, and development; and regulation, citizen participation, and social science, among others. The presence of persons with a wide variety of professional and philosophical viewpoints will, as in the past, stimulate improved coastal and ocean management through the best of current knowledge and cooperation.

For more information about this conference write to:

Orville T. Magoon/Gail Oakley
Coastal Zone 87
P.O. Box 279
Middletown, CA 95461
USA
Phone: (707) 987-2385

Canadian Hydrographic Conference - February 1987

The Canadian Hydrographic Conference was held in Burlington, Ontario, Canada from February 17 to 19, 1987. The Conference program included several technical sessions on positioning systems, multi-transducer systems, charts and publications, navigation and other interesting aspects of hydrographic surveying.

The conference was sponsored by the Canadian Hydrographic Association and the Canadian Hydrographic Service.

Conference on Volcanoes, 18-25 January 1987

More than 500 volcano researchers from around the world gathered on the island of Hawaii to attend a symposium on volcanoes on 18-25 January 1987.

"El Nino" Meeting - November 1986

The Fifth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of "El Nino" took place in Quayaquil, Ecuador, on 3-5 November 1986. The session dealt with problems related to monitoring and prediction of the "El Nino" phenomenon in the South-East Pacific, the IOC sponsored Global Sea-Level Observing System (GLOSS), and the IOC-WMO Intergrated Global Ocean Service System (IGOSS). CPPS stands for Permanent Commission for the South Pacific. IOC has published the Proceedings of this meeting.

2nd International Earthquake Conference, 6-10 April 1987

The 2nd International Earthquake Conference took place in Los Angeles on April 6-10, 1987. The Conference focused on government, private sector, and community efforts to develop earthquake research, mitigation, response practices, public agency training and disaster preparedness and education.

Pacific Congress on Marine Science and Technology, International

The following announcement was circulated by PACON International:

A new organization has been formed to respond to the need for international cooperation in matters affecting the Pacific nations. The Pacific Congress on Marine Science and Technology, International, is an organization of marine scientists and engineers, dedicated to advancing the state-of-the-art and the appropriate application of the art to the nations of the Pacific. The ocean is of vital interest to all nations and technology is the common language that unites us in our endeavor to learn more about it. PACON represents all of the national interests bordering the Pacific Ocean. Its members are people who are also members of local marine societies. The International organization provides an international forum for discussions that are of interest to all of the nations of the Pacific or at least to those in a particular region. The organization is governed by sustaining members whose contributions defray most of the cost of administration. The Board of Directors includes a representative from every nation and/or state.

The earth's last frontier, the oceans, present innumerable challenges to the marine scientist and engineer. An almost endless source of food and natural resources, the ocean is a forbidding environment and, as we are learning very late, a fragile relationship of water, animal life and plants. The ocean affects our food supply, our weather, our health, and our economic well-being. Within the vast territory served by PACON are nations that are out-front in advanced marine technology as well as nations that have little knowledge other than its existence. All of us, however, have need for information about the ocean and for solutions to problems that it presents. PACON has a principle goal of providing information freely to all of the participating nations, to promote the environmentally-sound exploitation of the ocean's resources, and to advance the knowledge in the various ocean disciplines.

Over the past five years, a group of scientists and engineers in Hawaii have conducted two international conferences on marine technology and its role for the Pacific nations. PACON 84 and PACON 86 successfully showed the interest in collaboration on protecting the environment, exploiting its resources, and generally solving the problems inherent in matters affecting the Pacific Ocean. Participants at the conferences came from fifteen countries and totaled some 500 people. The topics ranged from naval hydrography to marine recreation. PACON International is an outgrowth of those conferences.

Membership in PACON, International entitles you to our Quarterly Newsletter, Membership Card, access to PACON technical representatives and library, and discounts on PACON registrations. For more information write to:

PACON, INTL
P.O. Box 1171
Kailua, Hawaii 96834
USA

SEASEE Executive Committee Holds Seventh Annual Meeting

The Southeast Asia Association of Seismology and Earthquake Engineering (SEASEE) Executive Committee held its seventh annual meeting on 1 November 1986 in Bangkok, Thailand. The Committee agreed to pursue the implementation of the Earthquake Hazard Mitigation Program in Southeast Asia which was started in 1982 with the cooperation of the US Geological Survey (USGS) and the Office of Foreign Disaster Assistance of the U.S. Agency for International Development (OFDA/USAD); approved amendments to the Constitution and By-Laws of the Association; and elected officers for CY 1987.

The future activities considered to be undertaken include some of the remaining tasks outlined in the general plan of the mitigation program. A planning study prepared by the USGS contained the general plan. These tasks are:

1. Development of seismic hazard and risk maps.

2. Vulnerability studies of selected urban centers.

3. Regional study of long-period ground motions from distant earthquakes.

4. Intensification of seismic data exchange and publication of preliminary epicentral parameters for earthquakes recorded in the region.

5. Conduct of a training program on the use of microcomputer on seismological data reduction.

ASIA/PAC Volcanological/Airspace Meeting, Bangkok, 15-19 September 1986

The first informal ASIA/PAC Volcanological/Airspace Meeting was held at Bangkok from 15 to 19 September 1986. The Meeting was attended by 20 participants from four States and one International Organization. The Meeting considered the amount of volcanic activity in the Asia/Pacific Region and provided a useful exchange of information and views on various aspects of the detection, monitoring and reporting of volcanic ash cloud movement.

"Sea - The Future," International Symposium, September 1986

An International Symposium entitled "Sea - The Future, Perspectives in Ocean Technology," was held on 12-14 September 1986 in Vancouver, Canada. The events included such topics as Underwater and Offshore Resources, the Global Ocean Community and Ocean Technology and Resource Development, and other interesting topics related to the development of ocean resources.

Violent Forces of Nature

Lomond Publications Inc. with the cooperation of UNESCO, has published a book entitled "VIOLENT FORCES OF NATURE." Dr. Robert H. Maybury is the editor of the book, which is a compilation of some chapters which appeared in UNESCO's journal, impact of science on society. Chapter 11, on the impact of tsunamis on society is a contribution by Dr. George Pararas-Carayannis of ITIC. The book itself is a unique and excellent discussion of the major issues related to the nature of and the likelihood of major natural disasters, and public policy for preparing and coping with the onset of disasters. Dr. Robert H. Maybury has done a remarkable job in organizing and editing VIOLENT FORCES OF NATURE.

For more information and for ordering this book write to:

Lovell H. Hattery, Ph.D.
Publisher, Lomond Publications, Inc.
P.O. Box 88
Mt. Airy, MD 21771
USA
Phone: (301) 829-1496

Tsunami Data Announcement

The World Data Center-A for Solid Earth Geophysics in Boulder, Colorado, circulated recently a data announcement related to tsunamis. These include a Historic Tsunami Data Base consisting of about 1450 events, compiled from the Catalog of Tsunamis in the Pacific Ocean, authored by K. Iida, D. Cox and G. Pararas-Carayannis. Also, the announcement includes information on a wall-size multicolor map depicting Pacific Basin Tsunamis from 1900 to 1983. A total of 405 events are listed (including earthquakes, volcanic eruptions, and landslides) that caused tsunamis during that period.

Other items listed in the data announcement include the availability of tsunami photographs and slides, and the availability of catalogs of tsunamis in Alaska (by Doak C. Cox and George Pararas-Carayannis), in Hawaii (by George Pararas-Carayannis), and in Peru-Chile (by Pat Lockridge). In addition, the announcement states the availability on microfische of 3,100 tide gauge records of tsunamis dating back to 1850.

For more information and to order, write to:

National Geophysical Data Center
NOAA, Code E/GCA, Dept. F14
325 Broadway
Boulder, CO 80303
USA
Phone: (303) 497-6541 (FTS 320-6541)
Telex: 592811 NOAA MASC BDR

Coastal Hazards Conference, Ensenada, Mexico - August 1988

Coastal Hazards Conference, sponsored by the Centro de Investigacion Cientifica y de Educacion Superior de Ensenada (CICESE), the Tsunami Society, ITIC and PACON will be held at the Convention Center in Ensenada in August 1988. This is the third biannual conference dealing with natural and man-made hazards. The theme of this particular conference will be coastal hazards. More details and information on the conference will be published at the next issue of the Newsletter.

For more information write to:

Hazards Conference 88
Suite 6
2919 Kapiolani Blvd.
Honolulu, HI 96826

ABSTRACTS

Selected Papers of Professor Kinjiro Kajiura

A volume of twenty selected papers written by Professor Kinjiro Kajiura were published by the Department of Tsunami and Storm Surges of the Earthquake Research Institute, University of Tokyo, in May 1986. A number of these papers pertained to tsunamis. The volume was produced upon Professor Kinjiro Kajiura's retirement from the Earthquake Research Institute. For a copy of this volume write to:

Dr. Yoshinobu Tsuji
Earthquake Research Institute
University of Tokyo
Bunkyo-ku
Tokyo, Japan (113)
Cable Address: Zisinken Tokyo
Telex Number: 272-2148(ERI TOK)

The Pacific Tsunami Warning System

by George Pararas-Carayannis
Earthquakes and Volcanoes, Vol. 18, No. 3, pp. 122-130, 1986

Numerical Modeling of Water Waves

by Charles L. Mader
University of California Press
Berkeley and Los Angeles, California

Abstract: The objective of this monograph is to describe the numerical methods for modeling water waves that have been developed at the Los Alamos National Laboratory over the last two decades and to describe some examples of the applications of these methods. Most of the applications of the numerical modeling methods were performed while the author was working at the Joint Institute for Marine and Atmospheric Research at the University of Hawaii. In this monograph, the basic fluid dynamics associated with water waves are described.

A New Approach for a Quick Estimation of the Seismic Moment, Magnitude Mm ?

by J. Talandier & D. Reymond
Laboratoire de Geophysique
Commissariat a l'Energie Atomique
B.P. 640 - Papeete, Tahita, French Polynesia

Abstract: We propose, on the basis of recordings of 94 Pacific inter-plate earthquakes by the PPT station situated in the Central South Pacific, a new method for rapid determination of the seismic moment, by simply using the amplitude of the long periods of the vertical component of Rayleigh waves; we define experimentally, a Magnitude scale Mm, directly proportional to the decimal logarithm of the moment and to energy released by the earthquakes. This new magnitude scale, which takes account of the longest Rayleigh wave periods must not sustain, as with Ms, the saturation effect which occurs when the length of rupture of the fault is superior to the length of the wave used to determine the magnitude. Computation of the Mm magnitude takes into account the geometrical spreading and anelastic attenuation. Attenuation coefficients are regionalized by blocks of 10 x 10 degrees. For the Pacific, one uses the group velocities and quality coefficients of four different age models.

Real-Time Monitoring and Modeling for Tsunami Threat Evaluation

by George Curtis and Charles Mader
Joint Institute for Marine & Atmospheric Research
University of Hawaii, 1000 Pope Road, Honolulu, HI 96822

Abstract: Data from the May 7, 1986 tsunami illustrate the importance of (i) better, prompt knowledge of source factors, (ii) multiple deep ocean and coastal sensors and (iii) interacting this information with

an adequate data base in near real-time to produce a valid assessment of a tsunami threat. A program is outlined to apply such data from the May 7 event, the Mexico event of September 19, 1985, and others, in a hindcast simulation to evaluate the utility of running a model in real-time to improve tsunami warning. An iterative procedure would be used in an actual sequence; it is believed this would help resolve anomalies such as the Midway data of May 7. Data and problems associated with that day's warning are reviewed, along with feasible improvements. Recommendations from two working groups and other references are included.

Risk Assessment of the Tsunami Hazard

by George Pararas-Carayannis
Proceedings of the International Symposium on Natural and Man-made Hazards; Rimouski, Canada; August 3-9, 1986

Abstract: With the exception of the exceedingly rare impact of large meteorites, there are certainly no other natural hazards which are capable of ravaging such vast expanses of our planet with an intensity and suddenness comparable to that of large earthquakes. But even the effects of such large earthquakes are relatively localized compared to the devastating impact that their offsprings, tsunamis, can have, often across an entire ocean.

When the tsunami risk is potentially life-threatening or damaging to property, as often is the case, there is a paramount need to evaluate this risk in order to reduce or mitigate factors endangering public safety and property in coastal communities which have been historically impacted by such natural hazards. The risk potential of tsunamis is of extensive interest to governmental, non-governmental agencies, and to industries and the public in general. The interest of the insurance industry must also be directed toward this risk potential, particularly since in the last twenty years we have witnessed an unprecedented development of the coastal regions in most of the developed and developing countries of the world. Presently, the tsunami risk potential is frequently included in the coverage of insurance policies either explicitly or by implication.

Because the tsunami hazard frequency in the Pacific is the highest, most efforts in risk assessment and hazard management have concentrated in this area of the world. Other communities in other parts of the world are not immune to the tsunami hazard. No matter how remote, the likelihood of a tsunami should be considered in developing coastal zone management and land use. While some degree of risk is acceptable, government agencies should promote new development and population growth in areas of greater safety and less potential risk. These agencies have the responsibility of evaluating the tsunami hazard and establishing adequate warning procedures to protect

the communities under their jurisdiction. Furthermore, these agencies should establish proper training for public safety personnel, and formulate land-use regulations for given coastal areas particularly if these areas are known to have sustained tsunami damage in the past. Finally, in designing important engineering structures in the coastal zone, the risk resulting from the tsunami hazard should be evaluated and construction should incorporate adequate safety features. This paper provides some of the appropriate guidelines and methodology needed for the evaluation of the tsunami risk in terms of frequency of occurrence, severity of impact, design adequacy of important coastal structures, and finally, in terms of preparedness and planning for hazard mitigation.

PACIFIC TSUNAMI WARNING CENTER

PTWC Visitors

The Pacific Tsunami Warning Center (PTWC) in Honolulu was visited recently by several scientists returning from the Volcano Conference held in Hilo, Hawaii. Among them were Dr. Hirao Kanamori of the Pasadena Seismological Observatory of the California Institute of Technology, Dr. Jacques Talandier of the Laboratoire de Geophysique at Tahiti, and Dr. Emil Okal of Northwestern University.

Seismic Summary (1 July 1986 to Press Time)

EVENT NO.	EVENT	LOCATION	ACTION TAKEN
1986-11	Jul 09 2311Z 6.5	Molucca Sea, Indonesia 01.9N 126.6E	No Earthquake Information Bulletin issued
1986-12	Aug 14 1939Z 7.6	Molucca Sea, Indonesia 02.5N 126.6E	Issued Earthquake Info Bulletin
1986-13	Aug 30 2129Z 6.7	Romania 19.5N 155.9W	No Earthquake Information Bulletin issued
1986-14	Sep 16 1820Z 6.6	Mariana Islands 19.5N 146.4E	No Earthquake Information Bulletin issued
1986-15	Oct 14 1653Z 6.7	Papua New Guinea area 03.9S 153.7E	Issued Earthquake Info Bulletin

Seismic Summary (1 July 1986 to Press Time) - con't

EVENT NO.	EVENT	LOCATION	ACTION TAKEN
1986-16	Oct 20 0646Z 8.1	Tonga-Kermadec Trench 28.4S 176.4W	Issued Regional Tsunami Watch Bulletin 001, Supplemental Watch Bulletin 002, Watch Cancellation Bulletin 003
1986-17	Oct 30 0129Z 6.5	Tonga Islands 21.2S 176.6W	No Earthquake Information Bulletin issued
1986-18	Nov 14 2120Z 7.7	Taiwan area 24.2N 121.9E	Issued Regional Tsunami Watch Bulletin 001, Final Regional Tsunami Watch Bulletin 002
1987-1	Jan 03 2204Z 6.8	Vanuatu, Southwest Pacific 14.5S 167.9E	Earthquake Information Bulletin issued
1987-2	Jan 05 1212Z 6.5	Aleutian Islands 52.5N 168.6W	No Earthquake Information Bulletin issued
1987-3	Jan 30 2230Z 7.1	South Sandwich Islands 60.6S 029.4W	No Earthquake Information Bulletin issued
1987-4	Feb 08 1834Z 7.5	200 miles north of Port Moresby, Papua New Guinea 06.1S 147.9E	Earthquake Information Bulletin issued
1987-5	Feb 13 0719Z 6.8	Molucca Sea, Indonesia 01.4N 126.5E	Earthquake Information Bulletin issued
1987-6	Feb 27 0832Z 6.6	Unalaska, Aleutian Islands, Alaska 53.6N 167.3W	Earthquake Information Bulletin issued
1987-7	Mar 05 0917Z 8.0	Antofagasta, Chile 21.9S 070.3W	Regional Tsunami Watch & Regional Tsunami Watch Cancellation

Seismic Summary (1 July 1986 to Press Time) - con't

EVENT NO.	EVENT	LOCATION	ACTION TAKEN
1987-8	Mar 05 1140Z 6.9	Antofagasta, Chile 21.9S 070.3W	No Earthquake Info Bulletin issued, Watch in effect from previous event.
1987-9	Mar 06 0411Z 6.9	76 miles east-northeast of Quito, Ecuador 00.3N 077.6W	Earthquake Information Bulletin issued
1987-10	Mar 18 0336Z 6.6	Kyushu, Japan 31.9N 131.8E	Earthquake Information Bulletin issued